Electronic Version
Stylesheet Version v1.1.1

Claims

[c1] 1. A system for assessing a refrigerant charge level in a vehicle air conditioning system, the system comprising:
a first sensor for providing a cooled air temperature signal;
a second sensor for providing an ambient air temperature signal;
a third sensor for providing an ambient air humidity signal;
a fourth sensor for providing a compressor cycling signal;
a processing module for determining a refrigerant charge level as a function of signals from the first, second, third, and fourth sensors, and
an indicator for indicating that the level of refrigerant charge is acceptable if the refrigerant charge level is greater than a threshold value.

[c2] 2. The system of claim 1 further comprising a second indicator for indicating that the level of refrigerant is unacceptable if the refrigerant charge level is less than the threshold value.

[c3] 3. The system of claim 1 wherein the first and second

sensors are temperature sensors and the third sensor is a humidity sensor.

[c4] 4. The system of claim 1 wherein the fourth sensor is a voltage sensor.

[c5] 5. The system of claim 1 wherein the first, second, and third sensors are not disposed on the vehicle.

[c6] 6. The system of claim 1 wherein the fourth signal is provided to the processing unit by a powertrain control module mounted on the vehicle that controls engagement of a compressor clutch.

[c7] 7. The system of claim 1 wherein at least one of the sensors selected from the group consisting of the first sensor, the second sensor, and the third sensor, is disposed on the vehicle.

[c8] 8. The system of claim 7 wherein the third sensor is disposed on the vehicle and is connected to an air conditioning control module that controls an air temperature provided by the vehicle air conditioning system.

[c9] 9. The system of claim 7 wherein the processing module is connected to a powertrain control module mounted on the vehicle to receive the fourth signal.

[c10] 10. A method of assessing a level of refrigerant charge

in a vehicle air conditioning system with a refrigerant assessment system, the vehicle air conditioning system including a refrigerant subsystem having a compressor adapted to circulate a refrigerant and an air handling subsystem for providing air cooled by the refrigerant subsystem to a vehicle passenger compartment, and the refrigerant assessment system including a control module adapted to receive a first signal indicative of a cooled air temperature, a second signal indicative of an ambient air temperature, a third signal indicative of an ambient air humidity, and a fourth signal indicative of cycling of the compressor between engaged and disengaged states, the method comprising the steps of:

calculating as a function of the first, second, third, and fourth signals a refrigerant charge value indicative of an amount of refrigerant in the vehicle air conditioning system;

determining whether the refrigerant charge value exceeds a threshold value indicative of a desired refrigerant charge amount; and

signaling that the level of refrigerant is acceptable if the refrigerant charge value is greater than the threshold value.

[c11] 11. The method of claim 10 further comprising the step of signaling that the level of refrigerant is not acceptable

if the refrigerant charge level is less than the threshold value.

[c12] 12. The method of claim 10 wherein the first and fourth signals are sampled more frequently than the second and third signals.

[c13] 13. The method of claim 10 wherein the level of refrigerant is determined as a function of the expression
A1 + A2(F1) + A3(F2) + A4(F3) + A5(F4) + A6(F5) + A7(F6) + A8(F7) + A9(F8) + A10(F9) + A11(F10) + A12(F11) + A13(F12)
where:
F1 is the larger numeric value of either 0 or (CYCLE COUNT - A14) where CYCLE COUNT is the number of times the compressor cycles between engaged and disengaged states,
F2 is the larger numeric value 0 or (A15 - CYCLE COUNT),
F3 is the larger numeric value of 0 or (VENT TEMPERATURE - A16) where VENT TEMPERATURE is the temperature of the air provided by the air handling subsystem to the passenger compartment,
F4 is the larger numeric value of 0 or (A17 - VENT TEMPERATURE),
F5 is the larger numeric value of either 0 or (CYCLE COUNT - A18),

F6 is the larger numeric value of either 0 or (HUMIDITY - A19) where HUMIDITY is the ambient air humidity,
F7 is the larger numeric value of either 0 or (A20 - HUMIDITY),
F8 is the larger numeric value of either 0 or (TEMPERATURE - A21) where TEMPERATURE is the ambient air temperature,
F9 is the larger numeric value of either 0 or (A22 - TEMPERATURE),
F10 is the larger numeric value of either 0 or (HUMIDITY - A23),
F11 is the larger numeric value of either 0 or (HUMIDITY - A24),
F12 is the larger numeric value of either 0 or (TIME - A25) where TIME is an amount of time that the compressor is engaged, and
A1 through A25 are constants.

[c14] 14. The method of claim 10 wherein the first signal indicative of a cooled air temperature is provided by a temperature sensor disposed near a vent aperture in the air handling subsystem.

[c15] 15. The method of claim 10 wherein the second signal indicative of an ambient air temperature is provided by a temperature sensor.

[c16] 16. The method of claim 10 wherein the third signal indicative of an ambient air humidity is provided by a humidity sensor.

[c17] 17. The method of claim 10 wherein the fourth signal indicative of cycling of the compressor is provided by a powertrain control module disposed on the vehicle.

[c18] 18. A method of assessing a level of refrigerant in an air conditioning system disposed in a vehicle, the vehicle having an engine, a compressor having a clutch and adapted to be driven by the engine and circulate a refrigerant to provide a cooling effect when the clutch is engaged, a duct for providing air cooled by the refrigerant to a vehicle passenger compartment, a first signal indicative of a cooled air temperature, a second signal indicative of an ambient air temperature, a third signal indicative of an ambient air humidity, and a fourth signal indicative of engagement of the clutch, the method comprising the steps of:
calculating as a function of the first, second, third, and fourth signals a refrigerant charge value indicative of an amount of refrigerant in the air conditioning system;
determining whether the refrigerant charge value exceeds a threshold value indicative of a desired amount of refrigerant in the air conditioning system; and
signaling that the level of refrigerant is acceptable if the

threshold value is exceeded.

[c19] 19. The system of claim 18 further comprising the step of signaling that the level of refrigerant is not acceptable if the threshold value is not exceeded.

[c20] 20. The method of claim 18 wherein the second and third signals are sampled less frequently than the first and fourth signals.